OIPE
APR 24 2007
PATENT & TRADEMARK OFFICE

Attorney Docket No. ALCOA 97-2301 (093683-010100)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Inventors : Roberto J. Rioja et al.
Serial No. : 10/678,290
Filed : October 3, 2003
For : ALUMINUM-COPPER-MAGNESIUM ALLOYS HAVING ANCILLARY ADDITIONS OF LITHIUM
Examiner : Janell Combs Morillo
Art Unit : 1742

MAIL STOP: Amendment
Hon. Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

SUPPLEMENTAL DECLARATION OF ROBERTO J. RIOJA PURSUANT TO 37 C.F.R. § 1.132

Sir:

ROBERTO J. RIOJA, declares that:

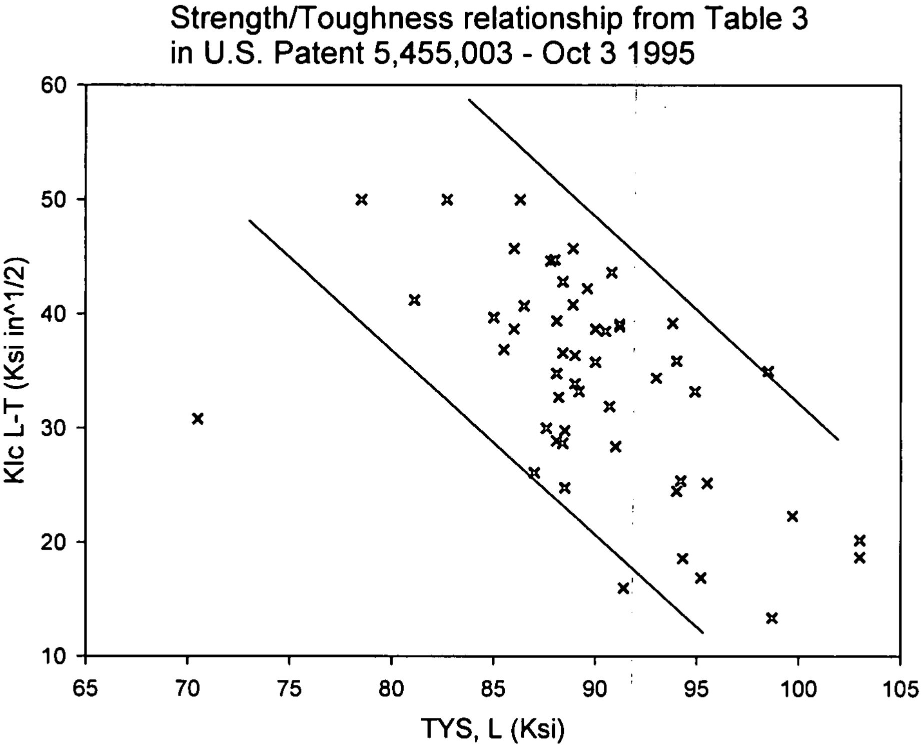
1. I am Roberto J. Rioja, one of the inventors herein and who submitted a Declaration dated February 5, 2005 in support of allowance of this application. I submit this Supplemental Declaration in further support of allowance of the application.

2. I am fully familiar with prosecution of the application and attended the personal interview with Examiner Morillo on April 11, 2006. The Exhibits annexed hereto were reviewed with Examiner Morillo during the Interview.

3. During the interview, I explained to the Examiner why the alloys as set forth in the amended claims are patentable. The reasons include (1) the positive strength/toughness relationship which is contrary to precedent and the technical literature; (2) the increase in resistance to fatigue crack growth even in the absence of the δ' phase in the alloy microstructure; and the outstanding

overall performance properties of the alloys claimed compared to state of the art non-lithium containing alloys in wide use today and another successful Al-Li alloy with a higher lithium content.

4. It is well known in the art that aluminum alloys generally exhibit a inverse relationship between yield strength and toughness. As the strength of the alloy is increased, the toughness decreases. This is widely reported in the literature as shown by Staley annexed to my earlier Declaration as Exhibit C and the data reported by Pickens in U.S. Patent No. 5,455,003. I prepared the following graph of the data in Pickens '003 in his Table 3:



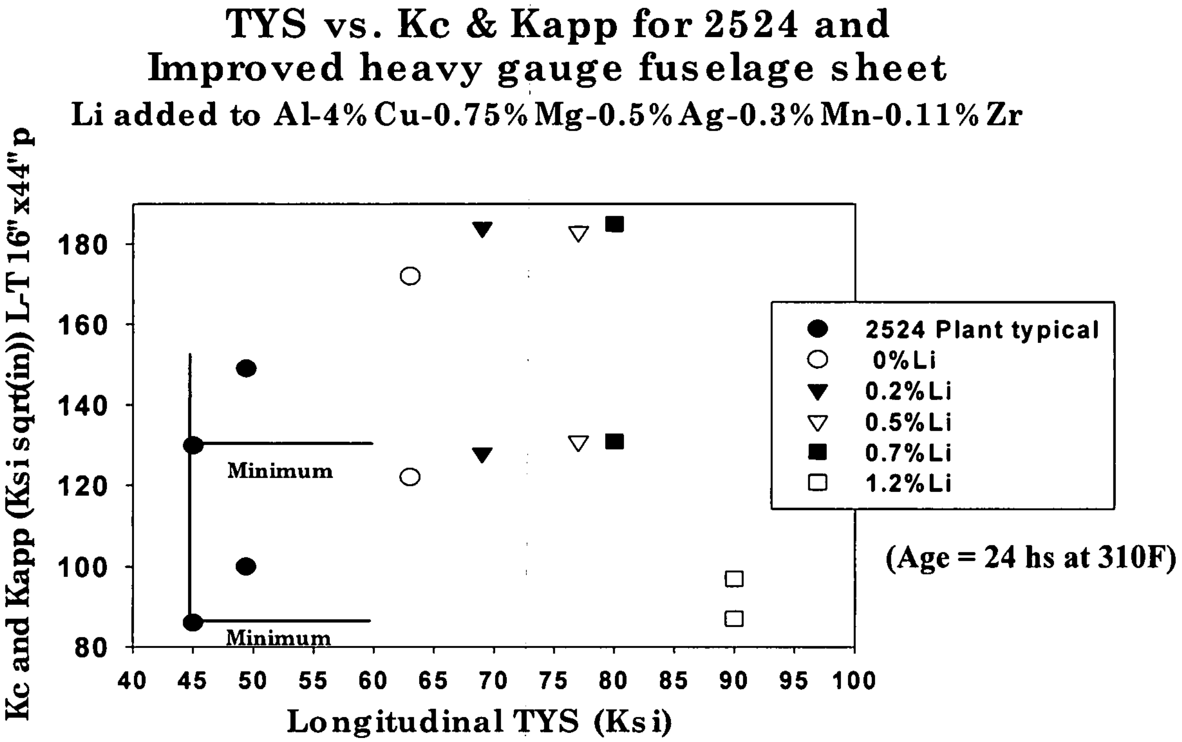
5. The Examiner noted in the previous Office Action at paragraph 7:

> The Examiner agrees that Pickens (as well as the prior art in general) teaches an inverse relationship between YS and toughness, and therefore an increase of YS and toughness (direct relationship) is unexpected.

6. The data set forth in Examples 1 and 2 of the application and illustrated in FIGS. 5 and 8 establish that for alloys prepared in accordance with the invention there is a direct relationship

between YS and toughness. Thus, an unexpected result has been established. This direct relationship has now been set forth in amended claims 1, 25 and 26.

7. FIG. 5 of the application shows the positive relationship between shows the positive relationship between strength as follows.



TYS vs. Kc & Kapp for 2524 and Improved heavy gauge fuselage sheet

Li added to Al-4%Cu-0.75%Mg-0.5%Ag-0.3%Mn-0.11%Zr

Point 1

RESULTS FROM CHEMICAL ANALYSES:

Alloy	S. No	Si	Fe	Cu	Mn	Mg	Zr	Li	Ag
1:	794510	0.06	0.04	4.0	0.3	0.76	0.11	-----	0.49
2:	596692	0.02	0.03	3.9	0.3	0.74	0.11	0.19	0.49
3:	596693	0.02	0.03	4.0	0.3	0.79	0.11	0.49	0.50
4:	596694	0.02	0.03	4.1	0.3	0.75	0.11	0.70	0.50
5:	596695	0.02	0.03	4.1	0.3	0.78	0.11	1.20	0.50

8. It is also know in the literature that resistance to fatigue crack growth increases with the presence of the δ' phase. This was shown to the Examiner in the photographs annexed hereto as Exhibit A, B, and C. Exhibit A is an electron microscope photograph of an Al-Li alloy with good fatigue crack growth resistance showing the δ' phase in the microstructure. Exhibit B is an enlargement of that photograph showing the D1 streaks and the δ'. Exhibit C illustrates the

microstructure of the claimed Al-Li alloy including about 0.75 weight percent lithium that exhibits the positive toughness/strength relationship, but does not show presence of δ' phase in the microstructure.

9. The overall performance of alloys prepared in accordance with the invention compare favorable to the standard AA2524-T3 utilized for fuselage structures and AA2324-T39 utilized in lower wing plate.

10. Exhibit D is a spider chart showing six performance properties for different alloys. these alloys are AA2024-T3, the 2000 series alloys utilized for fuselage structures. AA2524-T3 has replaced AA2024-T3 and is now the standard in the art and represents a significant improvement in fatigue crack growth resistance compared to AA2024. Alloy AA2199 includes about 1.6 weight percent lithium and shows yet a further improvement in fatigue crack growth with significantly lower density. The fracture toughness and yield strengths are substantially the same as the 2524-T3.

11. The alloy noted as C14E-T8 is an alloy prepared in accordance with the claims including about 0.75 weight percent lithium. This alloy exhibits significantly greater tensile yield strength compared to AA2524, the accepted standard in the art. Thus, the damaged tolerant properties including the fracture toughness and fatigue crack growth resistance are superior for the alloys prepared in accordance with the invention compared to state of the art materials.

12. Exhibit E is another spider chart comparing the C14E alloy with 0.75 weight percent lithium to the AA2324-T39 that is currently utilized in lower wing skin applications. The AA2324-T39 is the standard in the art utilized for lower wing skin structures. Also included is a comparison with AA 2199 (including about 1.6 weight percent lithium). These lower wing components are under tension when an aircraft is in flight, and under compression when on the ground.

13. As shown in Exhibit E, AA2199 at lower density exhibits greater fatigue crack growth resistance and has a higher modulus at a lower density than the AA2324-239 alloy. However, the yield strength is somewhat reduced.

14. In marked contrast to this, the physical properties of the alloys prepared in accordance with the invention exceed the AA2324-T39 state of the art material in all measured physical properties. This is indeed surprising and unexpected.

15. In sum, (1) the strength/toughness relationship is positive for alloys prepared in accordance with the invention. This trend has no precedent in those against teachings in the high technical literature; (2) the claimed alloys have greater resistance to fatigue crack growth even in the absence of the δ' phase; and (3) physical properties measured on experimental plate and sheet samples show performance superior to any other product currently in use for both lower wing skin or fuselage applications.

16. In view of the unexpected showing without explanation for the alloys disclosed and claimed in the application, and supported by the accompanying Exhibits, I respectfully submit that the alloys prepared in accordance with the invention demonstrating a positive strength/toughness relationship for additions of about 0.01 to about 0.8 weight percent lithium to comparable Al-Cu-Mg alloys is indeed surprising and represents a substantial advance in the art. In view of this, I respectfully submit that the amended claims setting forth this positive strength/toughness relationship are indeed not show or suggested in the prior art and are patentable thereover. Favorable action is requested.

Dated: April 23-07
Alcoa Center, PA
April 23, 2007

Roberto J Rioja
Roberto J. Rioja

Commonwealth of Pennsylvania
County of Westmoreland

On this, the 23 day of April, 2007, before me personally appeared Roberto Rioja, known to me to be the person whose name is subscribed to the within instrument.

In witness whereof, I hereunto set my hand and official seal.

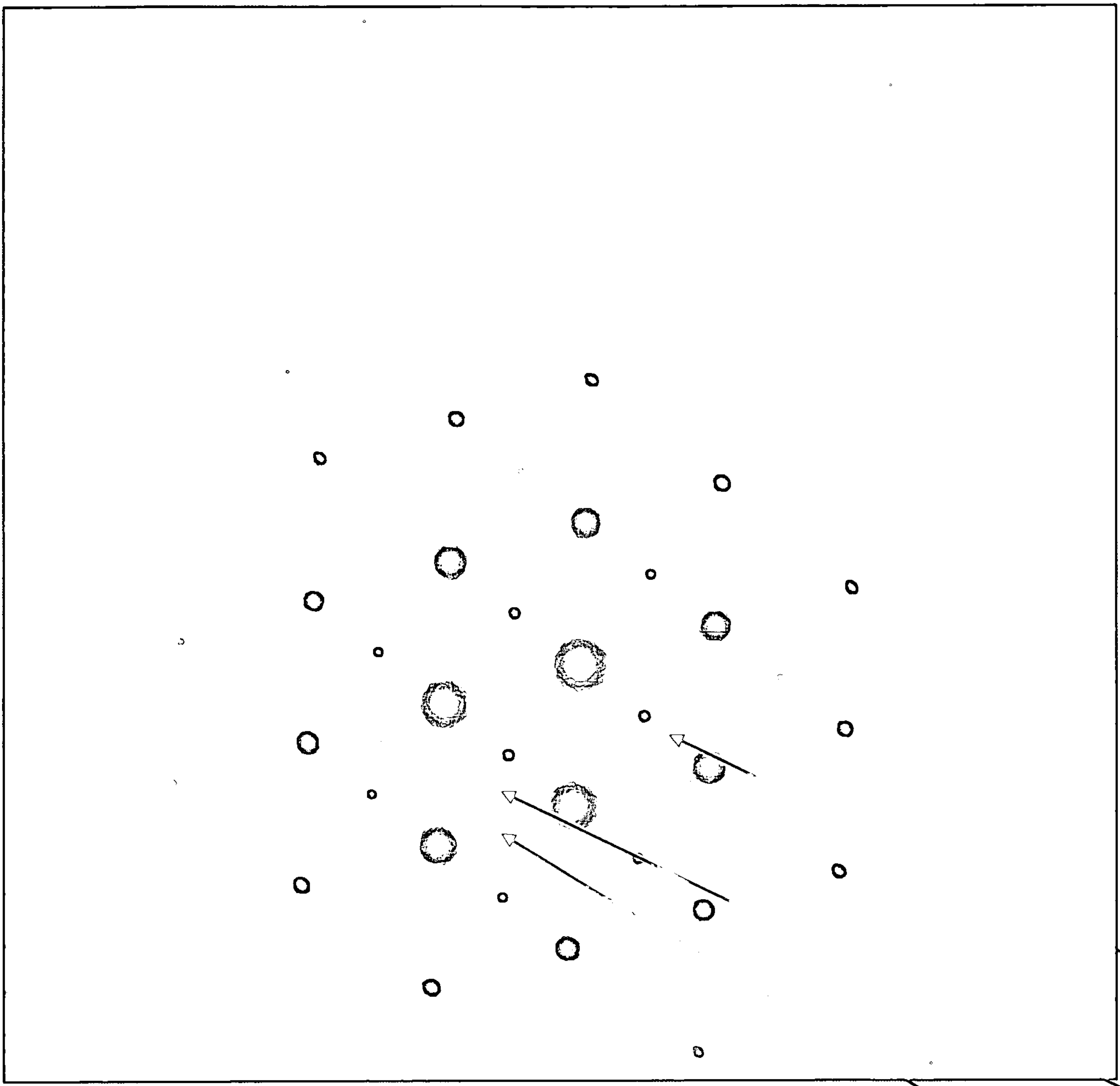
Virgine M Laible
Notary Public

COMMONWEALTH OF PENNSYLVANIA
Notarial Seal
Virgine M. Laible, Notary Public
Upper Burrell Twp., Westmoreland County
My Commission Expires Dec. 17, 2007
Member, Pennsylvania Association of Notaries

Al-Li alloys with good FCG show δ' in the microstructure

Point 2

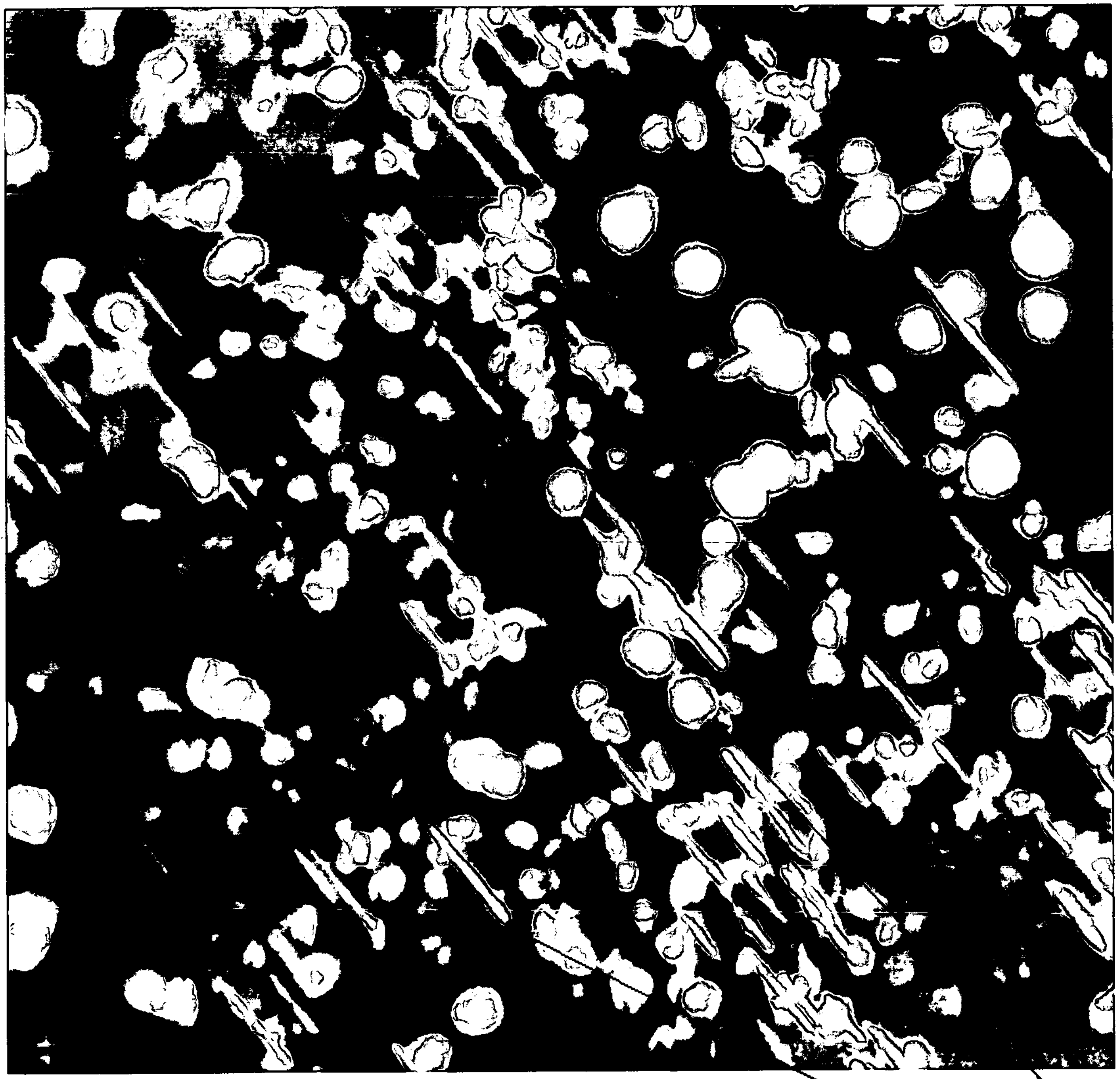
OIPE IAP34
APR 2 4 2007
PATENT & TRADEMARK OFFICE



C47A 24hs at 290F

Note T1 streaks, T1 spots and δ'

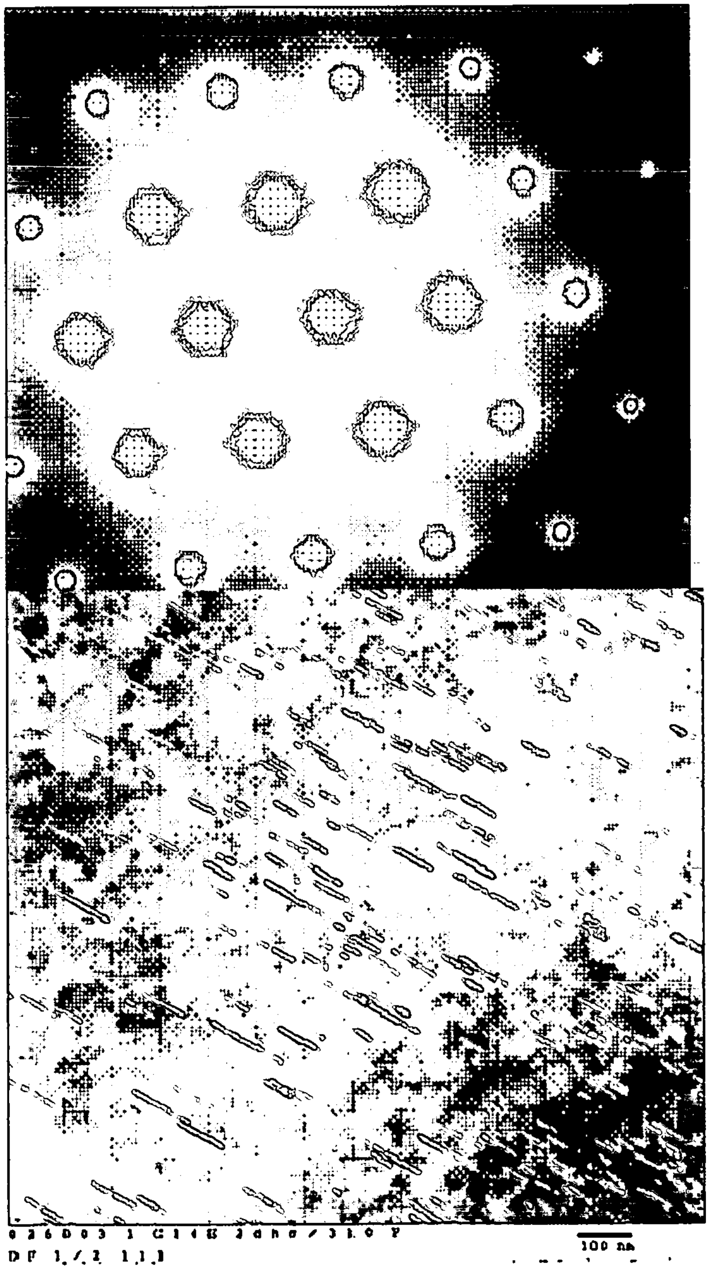
Point 2

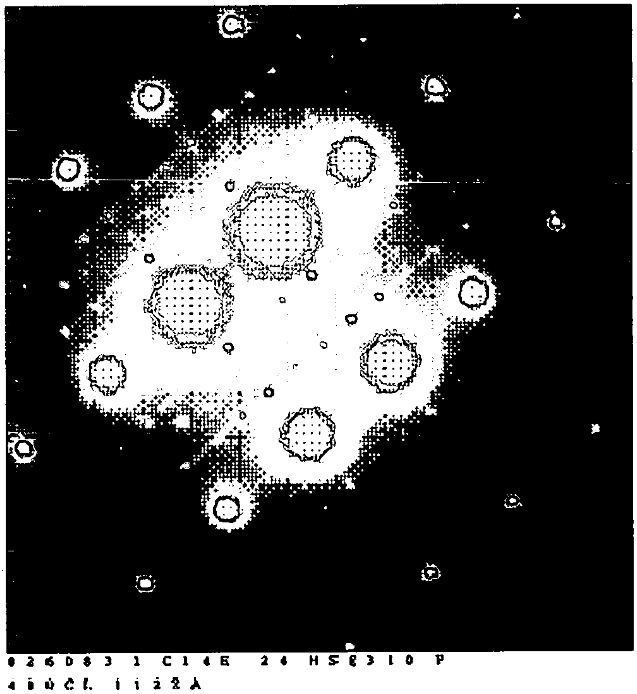


C47A 24hs at 290F

Note T1 and δ'

Strengthening precipitates in C14E





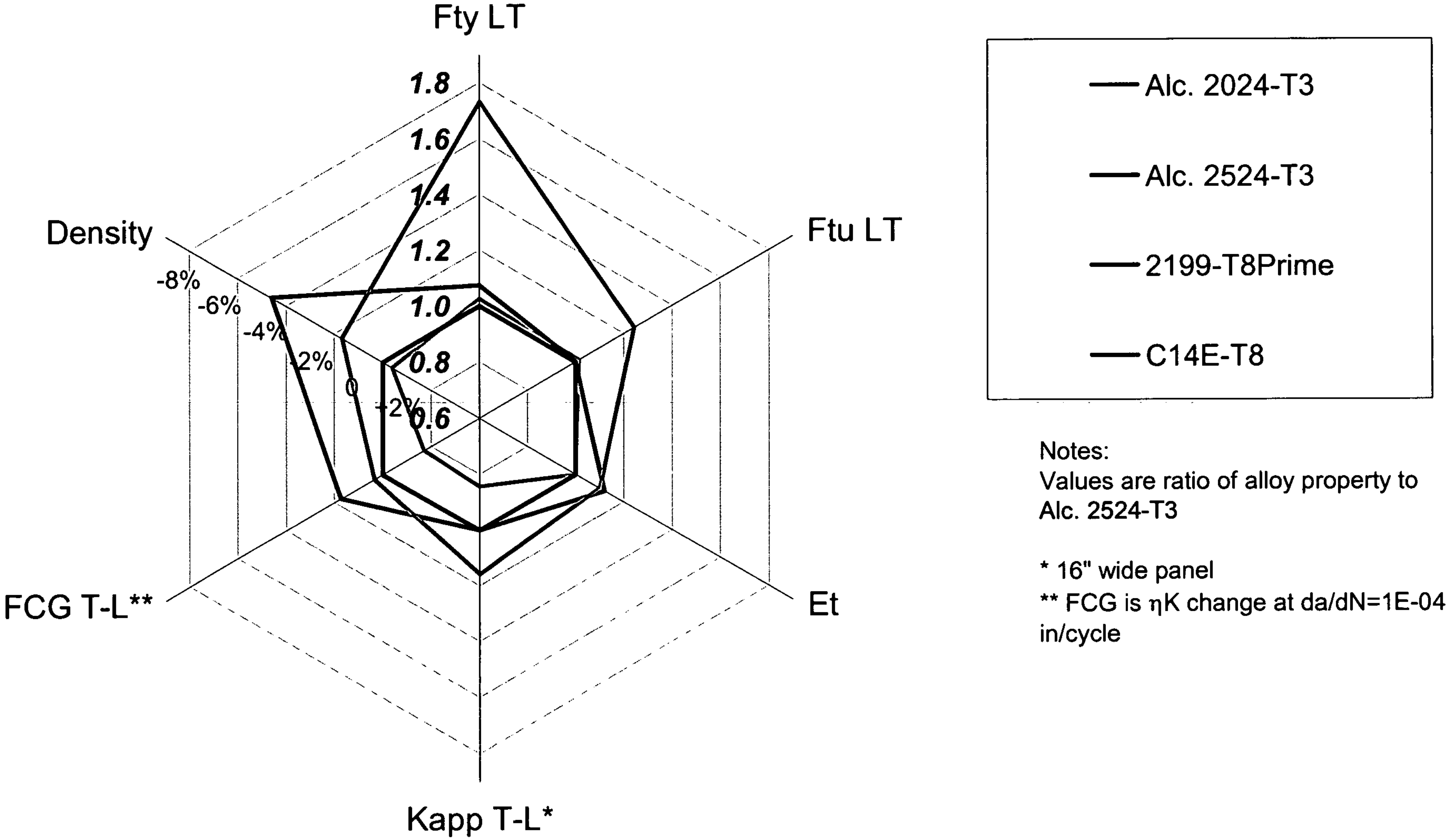
C14E Rx sheet aged 24 hs at 310F

Strengthening precipitates are T1

Point 2

Good FCG in absence of δ'

Fuselage, built-up structure

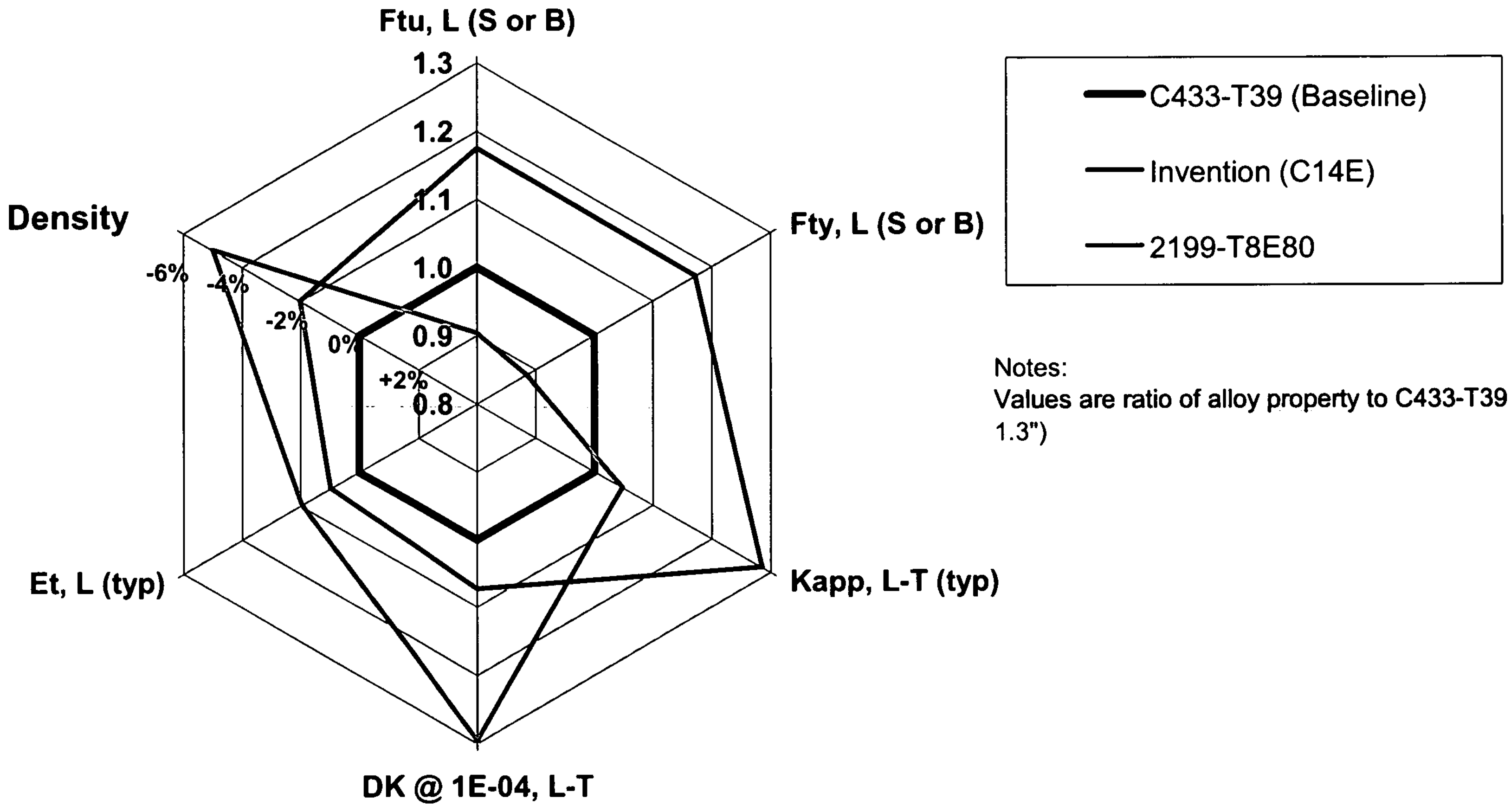


Notes:
Values are ratio of alloy property to Alc. 2524-T3

* 16" wide panel
** FCG is ηK change at da/dN=1E-04 in/cycle

Point 3

Lower Wing Plate Alloys for Built-up – Property Ratios



Notes:
Values are ratio of alloy property to C433-T39 (1.0 - 1.3")

Point 3: Highest strength/toughness alloy we have seen